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DEVELOPMENT OF ARTIFICIAL NEURAL NETWORKS IN THE DIGITAL ECONOMY

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Annotation

The article discusses an artificial neural network and trends in the development of neural networks in the digital economy. Particular attention is paid to machine learning technology. The practical implementation of the functioning of an artificial neural network is reflected in the manufacturing sector, robotics, education and economic activities of enterprises and organizations.

Keywords

artificial neural network, neural network technologies, artificial intelligence, machine learning, digital economy, industrial enterprises.

In the past few years, there has been an increased interest in neural networks, which are successfully used in various scientific fields - economics, medicine, technology, geology, physics. Neural networks have entered the practical application where it is necessary to solve the problems of forecasting, classification or control.

For decades, scientists around the world have been working to create artificial intelligence that could match and surpass that of humans.

Thus, one of the most important in the history of the development of artificial intelligence was the victory over a person in checkers, chess, and on March 16, 2016 (using the AlphaGo computer program developed by the British company Google DeepMind) in go, a board game that originated in ancient China, which was considered before that, it is impossible for artificial intelligence to win, because logical thinking alone is not enough to win.

Such a breakthrough was made thanks to the invention of an artificial neural network. Scientists have created this unique self-learning computer algorithm in the image and likeness of the neural network of living organisms.

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Artificial neural network today is one of the most advanced areas in the field of artificial intelligence. John McCarthy, an American computer scientist, proposed the term "artificial intelligence" in 1956 at a conference at Dartmouth University. In his opinion, intelligence within this science is understood only as a computational component of the ability to achieve goals. Today it is a catch-all term covering everything from robotic process automation to real robotics. Recently, it has gained prominence, in particular, due to large amounts of data (Big Data), as well as an increase in the speed of data processing, the size and variety of data collected at a given point in time. It should be noted that robotics is now developing exponentially and for it just neural network algorithms are a powerful tool for the development of control systems, image recognition systems, audio recognition systems and other information technologies.

So, an artificial neural network is a model of the work of biological neurons - brain cells, which is represented by a set of mathematical instructions written in the form of a program code. However, to call a neural network a classical algorithm is not entirely correct. It is much more complicated. A huge number of processes in it do not occur linearly, but in parallel at one point in time, i.e. just like in our brain.

In an artificial neural network, each neuron is represented as a processor. It has channels for receiving and outputting a signal. At the input, each signal passes through certain connections that mimic the synaptic activity of biological neurons, i.e. their ability to communicate information to each other. Each artificial neuron can work with only one unit of incoming information and performs the simplest function. However, as soon as they are networked, they can already cope with the most complex tasks that are beyond the power of conventional programming methods.

Today, artificial neural networks surround us everywhere. For example, when we write a query in Internet search engines, artificial neural networks find all the answers for us. It should be noted that these computing systems are capable of much more than solving routine tasks.

For example, in checkers, if we consider the tree of options from the beginning of the game to a win or a draw, there are approximately 1040 possible moves. In chess there are 10120 options. The variability of the decision tree is about 10400 scenarios. For example, to compare the values of these numbers, we note that the estimated number of atoms in the entire universe is approximately 1080. Therefore, this indicates a large amount of information processed by an artificial neural network.

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However, the main feature of the game is not that it is impossible to calculate all the options of the game, but that in order to win you need to connect intuition, a quality inherent in a person.

The principle of operation of artificial neural networks is based on the so-called machine learning. Machine learning is a class of artificial intelligence methods, the characteristic feature of which is not the direct solution of a problem, but learning in the process of applying solutions to many similar problems. There are two types of training:

- learning by precedents, or inductive learning, is based on the identification of empirical patterns in the data,

- deductive learning involves the formalization of experts' knowledge and their transfer to a computer in the form of a knowledge base.

Many inductive learning methods have been developed as an alternative to classical statistical approaches and are closely related to information extraction methods and data mining methods.

In this case, to develop intuition in the AlphaGo program, machine-learning technologies were used. Like humans, a neural network learns by trial and error. So, based on errors, the system corrects its work itself. This process is performed until the neural network begins to produce a consistently correct result.

The training period depends on the complexity of the task itself and the amount of data that the neural network must remember. So, it can take months to train a neural network. For example, the AlphaGo program, which actually consists of several neural networks at once, was trained to play Go for six months on 50 GPUs working in parallel or distributed using the Google Cloud platform, whose servers are located in the United States. It should be noted that a feature of distributed multiprocessor computing systems, in contrast to local supercomputers, is the possibility of unlimited increase in performance due to scaling.

The neural network was trained to predict the next move based on a large number of games played. At this time, as another neural network was trained to guess who will win. Those. intelligence lies in the fact that no one explained to the program how to play correctly. The machine has learned to do it itself.

The main world leaders in the field of neural network technologies should be considered Google and its divisions (DeepMind, AlphaGo, and Google Brain), Microsoft (Microsoft Research), IBM, Facebook (Facebook AI Research division) and others.

So, another no less significant success in the field of artificial neural networks is the IBM supercomputer Watson (named after IBM founder Thomas J. Watson).

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In February 2021, the supercomputer took part in the Jeopardy! TV show. The main advantage of Watson is that it understands questions in natural language and answers them by analyzing a large amount of data. His rivals were Brad Rutter - the owner of the biggest win in the program, and Ken Jennings - the record holder for the longest unbeaten streak. During the game, Watson did not have access to the Internet. The computer won with $1 million, while Jennings and Rutter got $300,000 and $200,000 respectively.

Watson is powered by 90 IBM servers, each with four eight-core processors. It uses the fastest operating system, SUSE Enterprise Linux Server 11, and IBM DeepQA information retrieval software, which includes natural language processing and machine learning. The total amount of RAM is more than 15 terabytes. The system has access to 200 million pages of structured and unstructured information of 4 terabytes, including the full text of Wikipedia and 500 gigabytes of pre-processed information.

Watson is most actively used in medicine, helping to diagnose and treat cancer. Its memory contains more than 600,000 medical reports. It is also used in the financial sector, law, hospitality and many other industries. In addition, Watson is able to support the conversation.

IBM uses developed Watson technologies in the following areas:

- Education. Schools in the US are testing Teacher Advisor with Watson, a cognitive tool that offers advice on how to improve curricula and personalize learning programs.

- The science. Johnson & Johnson uses Watson to analyze scientific literature. From a large number of materials, Watson selects the necessary for faster and more efficient research.

- Safety. Rolled steel manufacturer North Star BlueScope Steel is going to use the Watson Internet of Things system to create solutions to protect workers in extreme situations. Workers will also wear devices to collect and process data. In the event of dangerous conditions for people, information will be immediately sent to the management of North Star.

- Cyber security. Cybercriminals break into the information systems of enterprises, and then sell access to them using the Internet. If there is a failure or fraud in one part of the world, the Watson system will alert other users of this system.

- Medicine. The University of North Carolina and 12 other cancer centers use Watson to analyze patients' DNA to develop personalized treatments.

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However, scientists note that until the moment when neural networks can surpass humans in all areas, and not just in logic games, it is still too far away.

If there is some understandable specific task with a large amount of data for training, then artificial neural networks can demonstrate results better than humans in it. As soon as it is supposed to work in complex complex tasks and it becomes necessary to apply the accumulated life experience to make decision.

To date, it is not possible to create an artificial intelligence similar to the human mind, because for this, scientists need to unravel all the secrets of the brain, and this is still beyond the power of science. However, this knowledge is sufficient for the development of certain areas of activity.

For example, Gartner, a research and consulting company, is confident that by 2020 artificial intelligence technologies will be present in almost all software products and services, and market leaders will be able to receive up to 30% additional profit through their use.

According to a survey by an American corporation specializing in the development and supply of hardware and software systems for data processing and analysis, 80% of commercial organizations either already use separate solutions based on artificial intelligence or are going to do so in the near future. At the same time, 91% of respondents noted significant difficulties with the introduction of artificial intelligence technologies: the lack of a suitable IT infrastructure and the shortage of specialists in this field.

In Russia, artificial intelligence technologies have already been implemented by: PJSC Bank URALSIB (analysis of customer data), MTS and M.Video (optimization of customer service with the issuance of personal recommendations), Alfa Insurance (determining the risk of fraud in an insured event), Aviasales (search for cheap air tickets) and some others, including industrial enterprises.

For example, Yandex Data Factory tools help with steel smelting. Thus, scrap metal used for steel production is often heterogeneous in composition. In order for steel to meet the standards, when smelting it, it is always necessary to take into account the specifics of scrap and introduce special additives. This is usually done by specially trained technologists. But, since such industries collect a lot of information about the incoming raw materials, the additives used and the result, this information can be processed with greater efficiency by the neural network. According to Yandex, the introduction of neural networks can reduce the cost of expensive ferroalloys by 5%.

Similarly, a neural network can help with glass recycling. The use of machine learning technologies will significantly reduce costs.

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Metallurgical, chemical and oil refineries collect and store terabytes of information about the progress and results of technological processes. Modern artificial intelligence algorithms can find hidden dependencies in the collected data, while doing it better and faster than a human, uncovering the untapped potential for improving operational efficiency and helping to make optimal decisions.

Consider an example of the operation of an information system for continuous production, in particular for an arc steel-smelting furnace. So the operation of this system is based on the following algorithm of work:

1. data collection;

2. training and adaptation of artificial intelligence based on statistical models for a specific furnace;

3. provision by the information system in real time of recommendations on the optimal control of the smelting process and adjustment of this process in accordance with the results achieved.

Thus, the operation of such an information system allows real-time assistance to the operator to optimize the production management process. It should be noted that, in contrast to human information system does not get tired and provides stable recommendations to ensure the production process in the best mode. In addition, the information system helps the furnace operator to reduce the operating time under current by 10%, reduce the cost by more than 3%, and ensure stable quality. As noted above, such systems can be used in metallurgical, chemical, oil refining and power generation industries. The introduction and use of the information system does not require a deep modernization of production, which is a significant advantage.

The neural network approach is widely used in medicine. A team of researchers from the University of Nottingham has developed four machine learning algorithms to assess patients' risk of cardiovascular disease. Data from 378,000 British patients were used for training. Trained artificial intelligence determined the risk of cardiac diseases more effectively than real doctors.

Artificial intelligence has significantly improved recommendation mechanisms in online stores and services. Algorithms based on machine learning analyze your behavior on the site and compare it with millions of other users. All in order to determine which product you are most likely to buy.

In agriculture, in May 2016, Cognitive Technologies began testing an unmanned tractor equipped with computer vision thanks to satellite sensors. Unmanned vehicles are supposed to be used for harvesting, weeding, spraying plants with herbicides and other processes.

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Note that unmanned vehicles, a concept that most large corporations, as well as technology companies (Google, Uber, Yandex and others) and startups, are working on, relies on neural networks in their work. Artificial intelligence is responsible for recognizing surrounding objects - be it another car, pedestrian or other obstacle.

A recent IBM survey found that 74% of automotive industry leaders expect smart cars to be on the road by 2025. Such IoT-integrated vehicles will collect information about passenger preferences and automatically adjust the interior temperature, radio volume, seat position and other parameters. In addition to piloting, the system will also inform about emerging problems (and even try to solve them itself) and traffic situations.

In logistics and manufacturing, automatic unmanned loaders are widely used. The use of artificial intelligence in marketing activities allows you to collect and quickly analyze information about thousands of users to promote goods and services.

In the field of personnel management, artificial intelligence is already being used to process resumes, conduct interviews, and also monitor the actions of employees to prevent fraud.

In addition, machine learning helps to recognize potential cases of fraud in various areas of life. A similar tool is used, for example, by PayPal - as part of the fight against money laundering, the company compares millions of transactions and detects suspicious ones among them. As a result, PayPal's fraudulent transactions are at an all-time low of 0.32%, while the standard in the financial sector is 1.32%.

The work of the police and firefighters already involves the use of artificial intelligence. The cameras installed, for example, in London, not only record the fact of a crime, but also independently prepare documents for sending to the prosecutor's office.

The use of artificial intelligence in the education industry makes it possible to automate the testing of tests, as well as to develop perfect methods for transferring knowledge.

For example, the robot Alantim, an employee of the Moscow Institute of Technology, lectures students on robotics and conducts a large-scale study of the interaction between people and smart machines.

This is the first robot to be accepted into an official position at the institute. Alantim was developed by Perm developers from Promobot.

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Alantim is able to maintain a meaningful conversation, answer questions. The robot remembers up to 1,000 faces, uses 400,000 speech modules in a conversation. The maximum operating time of the robot is 8 hours without recharging, the speed of movement is 5 km/h. Alantim saves and systematizes all the information received, and then sends it to the owners in the form of reports.

State-of-the-art technology and automation are increasingly penetrating our daily lives. Naturally, our home is no exception.

A smart home is one of the priority areas for the development of the Internet of things (IoT), in which a huge number of companies operate. The intelligent system "Smart Home" allows you to combine all communications into one and perform control and management using artificial intelligence, programmable and customizable to all the needs and wishes of the owner. So, the "Smart" house regulates the temperature in the room, starts the necessary equipment and performs dozens of other useful functions.

Summing up, it should be noted that in the future the use of artificial intelligence will only expand. There is a growing demand for high-level designers of automated systems and programmers. These professions are already called the professions of the future.

However, it should be noted that there are problems with the use and implementation of artificial intelligence.

The use of artificial intelligence has led to the gradual destruction of a number of professions in the labor market. Over time, cashiers, drivers, accountants, estimators will disappear - these and other operations are already performed by machines. This will lead to a sharp increase in unemployment, as well as increased demands from employers. New qualified personnel will be required to work with automated systems, and this will lead to a revision of the education industry. The labor market will demand professionals with systems thinking who are ready to learn new things and master complex processes.

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